

## Root and Canal Anatomy of Maxillary and Mandibular Teeth in Rome Emparial

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### Abstract

In recent years, root and canal anatomy has been studied in detail by endodontists to ensure successful endodontic treatment. Today, the evolutionary trend in human dentition is towards simplification, although there is no exact information on when this trend first emerged. This study aims to investigate the root and canal morphology of the Late Roman populations living 1800 years ago. Nine mandibular and six maxillary jaws with teeth were scanned using X Radius Trio 3D Cone beam computed tomography CBCT (Castellini, Bologna, Italy) at 90 kVp, 13–16 mA, 13x16, 13x10 FOV, 0.03 mm voxel size. Multiplanar reconstruction images were obtained using iRYS (Castellini) software. After this scan, one premolar tooth among 39 teeth in the maxilla was identified as Vertucci Class VII. In the mandibular, all of the canines were single rooted; one of them was identified as Vertucci Class III. Of the first molars, all were two-rooted; two of them were identified as Vertucci Class VII and one of them as Vertucci Class VIII. All of the ten mandibular second molars examined were two-rooted, and no type C canal configuration was found. The root canal anatomy of the 81 scanned teeth showed considerable similarity to the root canal morphology of today's societies.

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**Keywords:** Roman, mandibular, maxillary, morphology, canal.

### 1. Introduction

The morphological characteristics of teeth have been extensively studied by dentists, anthropologists and, to a lesser extent, forensic specialists to determine the biological connection between the past and the present and assess the possible consequences (1) Recently, with the development of dental imaging technologies, different studies on the root and canal morphology of permanent teeth have shown considerable differences (2,3). This suggests that root canal anatomies are more complex than the simple canals described by Hess and Zurcher in 1925. The heterogeneity and anatomy of the root canal system have been classified by many researchers(4,5) but these classifications have varied for different populations worldwide. The complex anatomy of the root canal system and its different variations may

differentiate among populations worldwide (2). The exact etiology of these different variations and accessory canals is still poorly understood. In endodontic treatments, a thorough knowledge of the anatomy of the root canal system is necessary for successful treatment (6).

With the advantages in dental imaging technologies, anthropologic studies have gained importance in recent years. However, due to the limited anthropologic material, it has not been possible to conduct detailed studies on this subject. Therefore, there are very few studies on the anatomy of root canal systems in paleoanthropological studies (7,8). The limited studies in the anthropological literature and further studies will provide information about how root

and canal morphology has changed from past societies to the present.

This study aims to compare the root canal anatomy of specimens thought to be from the II–IV

## Materials and Method

This study was conducted with permission of the Ethics Committee of Harran University (HRÜ No. 24.16.04). The materials for this study originated from the Ancient Edessa rock tombs located in Kızılkoyun and Kale Eteği Necropolises in Grade II and III Archaeological Protected Areas in the Yeni Mahalle and Halepli Bahçe Neighborhood of Eyyübiye District of Şanlıurfa Province. The excavations were conducted by expert archaeologists working within the Provincial Directorate of Culture and Museums of the Şanlıurfa Governorship. Since the Kızılkoyun region has been used as a residential area up to today, the existing structures here were first expropriated and demolished. Then, the debris residues exposed here were removed from the environment. Rock grave chambers were opened using protective equipment, such as masks, overalls, visors and gloves, against infectious diseases and the risk of contamination. After the necessary examinations, the samples were numbered and stored in individually closed boxes as they were. Before the samples were scanned using CBCT, they were cleaned of soil and debris, again with complete protection against contamination and infectious diseases. Samples were scanned using X Radius Trio 3D CBCT (Castellini, Bologna, Italy) at 90 kVp, 13–16 mA, 13x16, 13x10 FOV, 0.03 mm voxel size. All scans were performed by specialized personnel using a special setup. Multiplanar reconstruction images were obtained using iRYS (Castellini Bologna, Italy) software.

## 2.Results

Eighty-one different teeth in nine mandibular and six maxillary jaws were scanned for this study using CBCT. The findings of the scanning showed that, of the 39 maxillary teeth, all the central incisor, lateral incisor and canine teeth had a single root and Vertucci Class I canal structure. Of the seven maxillary first premolars, one had a single root, five had two roots and one had three roots; four had a Vertucci Class IV root canal anatomy, two had a Class V and one a Class VII root

century AD with current root canal anatomy after scanning with CBCT.

canal anatomy. Of the seven maxillary second premolars, five were single-rooted and two were two-rooted; two had a Vertucci Class I root canal anatomy, two had a Class II, one a Class III and two a Class IV root canal anatomy (Fig. 1).

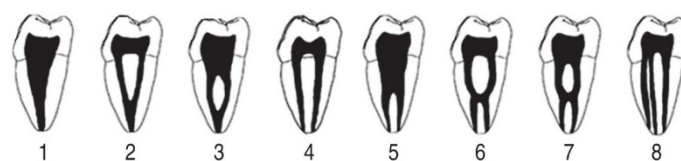


Figure 1. Vertucci classification of root canal configuration.

Examination of the eight maxillary first molars revealed that all of them had three roots and the distobuccal and palatal roots of these roots had a Vertucci Class I root canal anatomy. With respect to the mesiobuccal canal, two canals had a Vertucci Class 1 root canal anatomy, four had a Vertucci Class II and two a Vertucci Class IV root canal anatomy (Fig. 2).

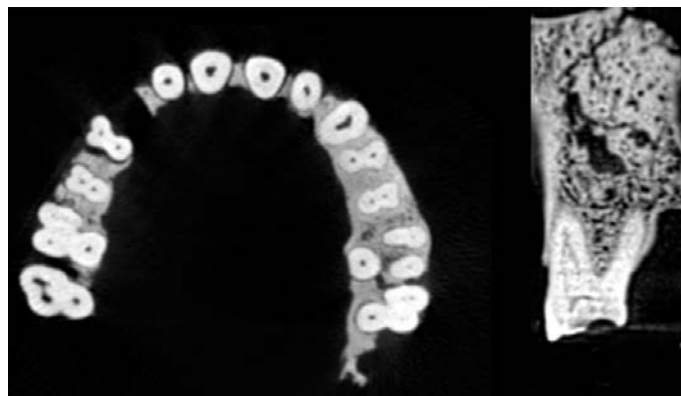


Figure 2. Cbct image of the maxillar first molar mesial canal with two canals.

Examination of six maxillary second molars revealed that all of them had three roots and the distobuccal and palatal roots of these roots had a Vertucci Class I root canal anatomy. The findings indicate that three of the mesiobuccal roots had a Vertucci class I, two a Class II and one a Class IV root canal anatomy.

Of the 42 mandibular teeth, one mandibular lateral incisor was single rooted and the root canal anatomy had a Vertucci Class III root canal anatomy. All eight mandibular canines were single rooted; five of them had a Vertucci Class I, two a Class II and one a Class III root canal anatomy (Fig. 3.) Of the six mandibular first premolars evaluated, five were single rooted and one was two-rooted; five had a Vertucci Class I and one a Class IV root canal anatomy. Evaluation of the five mandibular second premolar teeth revealed that four of them were single-rooted and one was two-rooted; the root canal anatomy of four was Vertucci Class I and one of was Vertucci Class V.

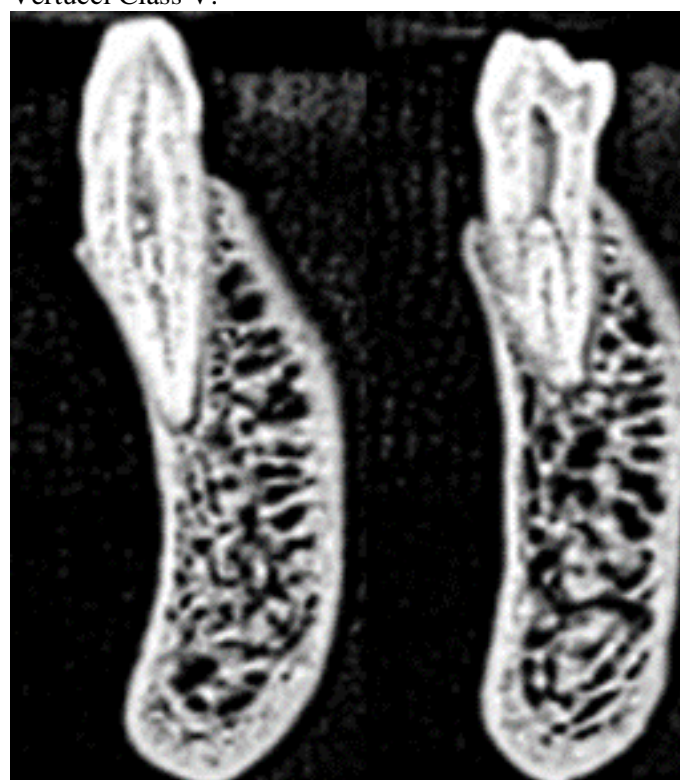
**Figure 3.** Cbct image of mandibular canine and premolar teeth.

All 12 mandibular first molars evaluated were revealed to have two roots. Of the mesial roots, eight were Vertucci Class IV, two were Vertucci Class VII, one was Vertucci Class VIII and one was not included in the classification [Fig. 4.]



**Figure 4.** Cbct image of right mandibular first molar with midmesial canal

Of the distal roots, eight were Vertucci Class I, one was Vertucci Class IV and three were Vertucci Class V. Evaluation of the 10 mandibular second molars revealed that, all of them had two roots. One of the mesial roots had a Vertucci Class I, two a Vertucci Class II, five a Vertucci Class IV and two a Vertucci Class V root canal anatomy. Of the distal roots, six were Vertucci Class I, two were Vertucci Class II and two were Vertucci Class IV. The findings are summarized in ( Table 1.)



**Table 1.** Vertucci classification of specimens, number of roots and root canals of the findings

Tooth Type	Number of Specimens	Number of Tooth Roots				Vertucci Classification									
		1	2	3	4	I	II	III	IV	V	VI	VII	VIII	Different	
Maxillary Central Incisor	2	2				2									
Maxillary Lateral Incisor	2	2				2									
Maxillary Canine	7	7				7									
Mandibular Lateral Incisor	1	1						1							
Mandibular Canine	8	8				5	2	1							

<b>Maxillary First Premolar</b>	7	5	2	1				4	2			1	
<b>Maxillary Second Premolar</b>	7	5	2			2	2	1	2				
<b>Mandibular First Premolar</b>	6	5	1			5			1				
<b>Mandibular Second Premolar</b>	5	4	1			4			1				
<b>Maxillary First Molar</b>	8			8									
Mesiobuccal						2	4		2				
Distobuccal						8							
Palatinal						8							
<b>Maxillary Second Molar</b>	6			6									
Mesiobuccal						3	2		1				
Distobuccal						6							
Palatinal						6							
<b>Mandibular First Molar</b>	12		12										
Mesial								8			2	1	1
Distal						8		1	3				
<b>Mandibular Second Molar</b>	10		10										
Mesial						1	2		5	2			
Distal						6	2		2				

### 3. Discussion

Root and canal morphologies vary from population to population and even within the same population (8,9). The role of genetics and racial variation may contribute to differences in the incidence of root number and canal number in human populations (10). Thus, the anatomical features of the root canal system should be carefully and thoroughly examined before root canal treatment. The success of nonsurgical root canal therapy depends on locating all canals and shaping, cleaning and filling the root canal system in three dimensions (11,12). Trope et al. found significant ethnic differences in their study on mandibular premolars, comparing African American and Caucasian patients in terms of both number of roots and number of canals. The incidence of two or more canals was 32.8% in African American patients compared to 13.7% in Caucasian patients (13). Root canal anatomy also varies within population groups. Sert et al., Çalışkan et al. found a prevalence of two or more canals (39.5% and 36%,

respectively) in studies conducted among the Turkish population (14,15). Since our study was performed on skeletal specimens, this variable was not taken into consideration in our study. This is one of the limitations of our study.

The one lateral and eight canine mandibular anterior teeth examined in this study all had single roots. The results of this study indicate that the mandibular anterior teeth were Vertucci Class I (55.5%), Class II (22.2%) and Class III (22.2%). As in our study, Vertucci Class I is the most prevalent type in many studies evaluating root canal anatomy (16-18).

Mandibular first and second premolars are defined as single-rooted teeth with oval roots in cross-sections and developmental pits on the mesial and distal aspects of the root surfaces (19,20). However, rare variations with two, three and four roots have been reported in the literature (13,21). Of the 11 premolars examined, six were first and five second premolars. Five of the first premolars were single-rooted and one was

two-rooted. Of the five second premolars, four were single-rooted and one was two-rooted. Llena et al. reported Vertucci Class I (78.1%), followed by Class V (12.3%), as the most common type of mandibular first premolar in the Spanish population (22). In our study, Vertucci Class I (83.3%) and Vertucci Class IV (16.7%) were observed for the first premolar. For the second premolar, Vertucci Class I (80%) and Vertucci Class V (20%) were observed. Liao Q et al., in a study conducted among a Chinese population, found that premolars of the Vertucci Class I were more prevalent, consistent with our study (3).

All 12 mandibular first molars we examined had two separate roots. The mesial roots were found to be Vertucci Class IV (66.66%), Vertucci Class VII (16.66%) and Vertucci Class VIII (8.33%). The distal roots were Vertucci Class I (66.66%), Vertucci Class V (25%) and Vertucci Class IV (8.33%). One tooth could not be included in any classification. Demirbuga et al. also found two completely separate roots for mandibular first molars, similar to our study (23). With regard to the mandibular second molars, all 10 primary teeth have two roots. The mesial roots were found to be Vertucci Class I (10%), Vertucci Class II (20%), Vertucci Class IV (50%) and Vertucci Class V (20%). The distal roots were 60% Vertucci Class I (60%), Vertucci Class II (20%) and Vertucci Class IV (20%). The fact that our study consists entirely of two-rooted teeth makes it different from many other studies (24,25). Another noteworthy point is the absence of a C-type canal configuration in our study. However, when we look at the literature, C-type canal configuration is found in many populations, even at low rates (24,25).

The maxillary central, lateral and canine teeth were classified as single-rooted and Vertucci Class I, which is similar to most of the current collections. The first premolars were found to be single-rooted (14.28%), two-rooted (71.42%) and three-rooted (14.28%). According to the Vertucci classification, Class IV (57.14%), Class V (28.57%) and Class VII (14.28%) were the most prevalent. Vertucci Class VII in first premolars is a rare classification, as it is today (26,27). With regard to the maxillary second premolars, one root (71.42%) and two roots (28.57%) were detected. One of the two-rooted teeth was Vertucci Class III (14, 28%), which is higher than the results of Kartal et al. (26). The remaining classification yielded similar results to the present. This difference in our study may be due to the limited number of specimens we examined. In addition, the first molars (100%) all had three roots. All of the distobuccal and palatal roots were Vertucci Class I, while

the prevalence of MB2 canals in the mesiobuccal root (75%) is similar to that in many other studies (28,29). The second molars (100%) all had three roots. However, today, two roots and four roots and different canal variations are found (30). This difference in our study may be due to the limited number of specimens we examined, similar to the situation with the first molars.

#### 4. Conclusion

Large-scale analysis of root canal systems has become a crucial issue for treatment success in endodontics. It is also necessary to investigate this topic anthropologically in different populations and races. However, due to the limited availability and lack of preservation of archaeological materials, such studies have not been conducted. This study determined, on the basis of tomographic examinations, that the root and canal morphologies of 81 teeth from nine mandibular and six maxillary jaws from a Late Roman population are similar to those of today's societies.

#### Conflicts of interest

"No potential conflict of interest relevant to this article was reported."

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#### Authors' contributions

N.Ç.- general guidance, final approval for the publication of the manuscript.

N.Ç., M.D.. - data collection, analysis and interpretation of the results

N.Ç., M.E. - development of the concept and editing of the text, final approval for the publication of the manuscript.

N.Ç., M.E., M.D.- collection, analysis and processing of the material, writing the text, checking critical intellectual content.

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